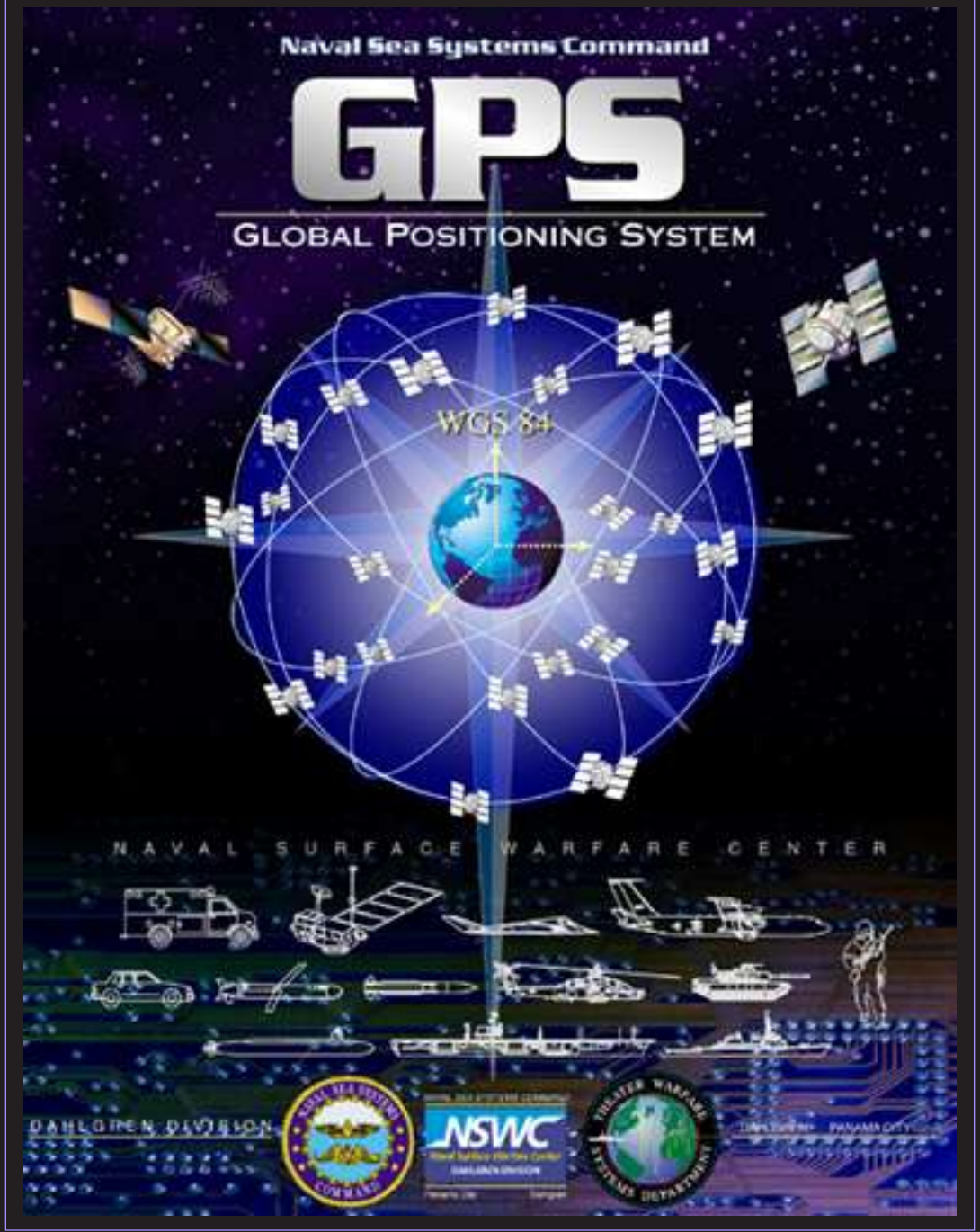
Naval Sea Systems Command
GPS
GLOBAL POSITIONING SYSTEM
WGS 84
NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION
NSWC

Overview

By the end of the 1960s, the Department of Defense (DoD) realized the need to develop a three-dimensional, all-weather, global navigation system to support military operations and systems development. The Naval Surface Warfare Center, Dahlgren Division (NSWCDD), with its extensive experience in Transit navigation satellite missions and orbit determination, was chosen to participate in the early development work for what would become the NAVSTAR Global Positioning System (GPS). Since then, GPS-related development at NSWCDD has expanded to include precise orbit and clock estimation, reference frame definition, precise positioning, and other military applications.

Originally intended just for navigation, GPS is now used for surveying, time synchronization, vehicle attitude determination, and numerous other purposes. It is used not only by DoD but by nearly every government agency and millions of private citizens worldwide. NSWCDD is proud to have played, and will continue to play, an important role in the development of GPS.

NSWCDD Contributions

During the past 30 years, NSWCDD has made significant contributions to GPS system performance, including key developments in the following areas:

- GPS constellation design
- Precise satellite orbit and clock estimation
- Tracking station positioning
- World Geodetic System development
- GPS receiver development
- Precise positioning and attitude
- Submarine Launched Ballistic Missile (SLBM) test and evaluation
- Space vehicle positioning
- 6-degree-of-freedom (DOF) modeling and simulation

Orbit and Clock Estimation

NSWCDD developed and now maintains the software system called OMNIS, which is used by the National Imagery and Mapping Agency (NIMA) to produce precise satellite orbit and clock estimates. This software system estimates orbits to an accuracy better than 10 centimeters and time to an accuracy better than 1 nanosecond. These estimates are used for DoD precision GPS applications. This software system can also be used to position static sites and space vehicles that track GPS.

WGS 84 Reference Frame

The World Geodetic System 1984 (WGS 84) global reference frame is fundamental to all applications of GPS. NIMA, with technical assistance from NSWCDD, defined the WGS 84 frame using satellite observations from all of the GPS tracking stations. Continuous algorithm improvements now enable GPS tracking station coordinates to be determined to an accuracy of a few centimeters. All GPS navigation solutions are defined in this reference frame.

GPS Applications

Early work on precise positioning and attitude determination required extensive post-processing of tracking data. Recently, through advances in computer technology and data processing techniques, greater accuracies have been achieved in real time. GPS applications at NSWCDD include:

- Missile testing and miss-distance determination
- Theater Ballistic Missile Defense (TBMD)
- Precise navigation (GPS/Inertial Measurement Unit [IMU])
- Automated pilotless aircraft landing
- Extended Range Guided Munition (ERGM)
- Near real-time targeting
- Antijam modeling and simulation

Future Efforts

NSWCDD is pursuing state-of-the-art technologies and analysis techniques that will ensure its continued presence at the forefront of precision GPS applications. These include:

- Very precise positioning and attitude
- Very high dynamic military applications
- Centimeter orbit accuracies
- Real-time 3-D positioning visualization

Analysis, Computation, and Visualization

NAVAL SEA SYSTEMS COMMAND
NSWC Naval Surface Warfare Center DAHLGREN DIVISION
Panama City Dahlgren
NSWCDD/MP-99/40: 3/99

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